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PREVENTING POSTOPERATIVE COMPLICATIONS IN THE ELDERLY

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SYNOPSIS

Postoperative complications are directly related to poor surgical outcomes in the elderly. This review outlines evidence based quality initiatives focused on decreasing neurologic, cardiac, and pulmonary complications in the elderly surgical patient. Delirium is the most common neurologic complication in the elderly. Important anesthesia quality initiatives for prevention of delirium in elderly surgical patients include use of structured clinical protocols focused on delirium risk factor modification, avoiding meperidine when managing postoperative pain, and careful selection and titration of drugs when sedation is required. There are few age-specific quality measures aimed at prevention of cardiac and pulmonary complications. However, some recommendations for adults such as avoidance of long acting muscle relaxants and perioperative use of statins and beta blockers in high risk patients can be applied to the geriatric surgical population. In the future, process measures may provide a more global assessment of quality in the elderly surgical population.

Keywords

geriatric; surgery; delirium; surgical procedures/adverse effects; postoperative complications; quality assurance; aged

BACKGROUND

The population is aging. This is because better medical care and living conditions have allowed people to reach an older age in better health than previously possible[1]. As the elderly have continued to grow in number, so has the number of surgical procedures

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performed on this segment of the population. Orthopedic surgery provides an example of this phenomenon. From 1990 to 2004 the number of total hip arthroplasties performed increased by 158%[2]. Adjusted rates of cervical spine fusions in the elderly rose 206% from 1992 to 2005[3]. Rates of surgery for spinal stenosis increased eightfold from 1979 to 1992 in the Medicare population[4]. Other surgical specialties such as urology have seen similar changes as demonstrated by a greater than 40% increase in surgical procedures for urinary incontinence in elderly females from 1991–2001[5]. Therefore, the practicing anesthesiologist can expect to manage ever greater numbers of geriatric patients in the future.

Outcome studies demonstrate that morbidity and mortality are increased following surgery in the elderly as compared to the younger population[6]. Among the many factors contributing to increased surgical morbidity and mortality[7], perioperative complications are directly related to poor outcome in the elderly[8]. In a study examining the effect of age on perioperative complications, Polancyzk et al. showed that fatal and major complications increase with age[9]. In addition, perioperative complications in the elderly are associated with greater mortality. Hamel et al. showed that patients 80 years of age and older who suffer complications after major surgery have a 25% greater 30 day mortality than patients without complications[10]. Thus, quality initiatives with great potential for improving surgical outcomes in elderly patients should target the prevention of perioperative complications[11].

It is the intent of this review to outline evidence based quality initiatives focused on decreasing postoperative complications in the elderly surgical patient. Of the many types of postoperative complications which may occur in the elderly, neurologic, pulmonary and cardiac morbidity is most common with a reported incidence of 15%, 7%, and 12%, respectively[12]. Because these types of complications form the lion's share of postoperative morbidity, the discussion will focus on evidence based guidelines to prevent neurologic, pulmonary, and cardiovascular complications in the elderly.

NEUROLOGIC

Neurologic complications are the most common type of complication in the geriatric surgical population[12]. Postoperative delirium is the most frequent type of neurologic complication with an incidence ranging from 15 to 53%, depending on the type of procedure[13]. Other important postoperative neurologic complications in the elderly include stroke and peripheral nerve injury. Because of its overwhelming importance, the discusssion will focus on quality initiatives for prevention of delirium.

Delirium quality control initiatives based on randomized controlled trials

Currently, the Cochrane database has identified only two interventions which have been definitively shown through randomized clinical trials to prevent delirium in hospitalized patients[14]. One intervention is the use of structured clinical protocols to assist in preventing episodes of delirium. Specialist delirium units which concentrate on assessment of delirium risk factors and targeted risk factor modification represent a best practice model[15] and should be a mainstay of clinical care. Table 1 outlines the risk factors specifically targeted with standardized protocols for management including cognitive impairment, sleep deprivation, immobility, visual and hearing impairment, and dehydration[16]. An alternative to the delirium unit is a combined geriatric-orthopedic approach using proactive geriatric consultation focused on modification of the above mentioned risk factors. This type of surgical care model was found to decrease delirium incidence in hip fracture patients by over one third[17].

A second intervention which decreases the severity of postoperative delirium is the prophylactic administration of haloperidol. This strategy has concentrated on patients

undergoing orthopedic procedures[18]. Low dose haloperidol (1.5 mg/day) given prophylactically to elderly hip surgery patients does not reduce the incidence of postoperative delirium, but does decrease the severity and duration of the delirium episodes[19]. Low dose prophylactic haloperidol should be considered in vulnerable populations undergoing high risk procedures.

Delirium quality control initiatives based on analysis of prospective and retrospective datasets

The remainder of the quality initiatives to be discussed focus on delirium prevention via control and/or elimination of modifiable risk factors. These risk factors for postoperative delirium have been determined via analysis of prospective and retrospective datasets. Except when specifically mentioned in this article, no definitive randomized trials exist which test the effects of risk factor modification on postoperative delirium.

Co-morbidities—The two most important risk factors associated with postoperative delirium are advanced age and dementia[20]. It is important to systematically evaluate older surgical for the possibility of dementia. This assessment will identify patients at high risk for postoperative delirium. Identifying vulnerable individuals will allow for the possibility of instituting structured delirium protocols or prophylactic drug administration.

Despite the fact that dementia is closely associated with onset of postoperative delirium, there is no evidence that many of the drugs used in managing dementia have efficacy in preventing delirium. Donazepil, when given prophylactically, does not decrease delirium incidence in elderly patients undergoing total joint replacement[21,22]. Similar studies with rivastigmine have also reported negative results[23].

Abnormal preoperative laboratory values (especially electrolytes and glucose) [24] and hemoglobin values less than 10 grams%[25] have been associated with postoperative delirium. Requirements for postoperative transfusion have also been associated with delirium [26, 27]. Correction of abnormal preoperative laboratory values is an important intervention in decreasing postoperative delirium. However, whether blood transfusion to increase hemoglobin levels has a significant effect on delirium severity has not been established. Recent evidence from randomized controlled trials suggests that transfusion alone is unlikely to impact the course of delirium in elderly patients with low postoperative hemoglobin (American Geriatrics Society abstract #b30; 2010 annual meeting).

Pain management—Control of postoperative pain is important in preventing delirium. Higher pain scores at rest during the first three postoperative days are associated with postoperative delirium in patients undergoing non-cardiac surgery[28]. Increased levels of both preoperative and postoperative pain are risk factors for development of postoperative delirium [29]. In the hip fracture population, Morrison et al.[30] found that cognitively intact individuals with poorly controlled pain were 9 times more likely to become delirious.

When selecting narcotics for pain management, there is no difference in cognitive outcome when comparing fentanyl, morphine, and hydromorphone[31]. Meperidine is the only narcotic that has been definitively associated with delirium[32,33]. When selecting the mode of administration, there is no difference in cognitive outcome when comparing intravenous vs. epidural administration of narcotics[31]. There is no evidence that postoperative delirium limits the use of on-demand patient controlled analgesia[34]. However, one prospective case series demonstrated an association between oral opioid administration and decreased risk of developing delirium as compared to intravenous patient controlled analgesia[29]. To summarize narcotic pain management in populations at risk for delirium, the strongest

evidence is in support of avoiding meperidine, evidence is weaker that mode of administration is an important factor.

Opioids themselves may induce delirium and elderly patients have increased cerebral sensitivity to opioids[35]. To circumvent these effects, non-opioid analgesics are increasingly utilized as a part of a multimodal pain management regimen. Several randomized studies have demonstrated that non-opioid based analgesics decrease postoperative pain and the need for opioids[36, 37]. In addition, meta analysis has demonstrated that NSAIDS are associated with a 30–50% decrease in opioid consumption and decreased morphine associated side effects[38]. Given the above, a multimodal approach to pain management utilizing non-steroidal anti-inflammatory agents or other non-opioids allows lower doses of drugs to be used, thus helping to reduce potential side effects[39].

Sedatives—Sedative medications are iatrogenic risk factors for delirium in ICU patients[40]. The use of opioids is strongly related to the development of ICU delirium[41]. Similarly, benzodiazepines such as lorazepam are an independent risk factor for the transitioning of ICU patients into delirium[42]. Among drugs commonly used in anesthetic practice benzodiazepines[32] have been implicated in the development of delirium. Dexmedetomidine may be the drug of choice for long term sedation in the ICU as several studies demonstrate that its use leads to a decreased incidence of ICU delirium[43,44]. There are no studies to date which demonstrate that dexmedetomidine has similar effects on delirium in the OR setting.

Medication management—Preoperative drug related risk factors for delirium include treatment with multiple psychoactive drugs, treatment with multiple drugs, and alcohol abuse[13]. Drug related risk factors which may precipitate postoperative delirium include use of sedatives, narcotics, and/or anticholinergics, polypharmacy, and alcohol or drug withdrawal[13]. The major psychoactive drugs associated with delirium are sedatives and narcotics which have been discussed previously. The general consensus is that medications with anticholinergic effects should be avoided [45] as these drugs are associated with increased central effects[46]. Simplification of the medication regimen is important to decrease the possibility of drug interactions involving the central nervous system. A patient's medication profile should be carefully assessed for any drugs that have been associated with delirium in the elderly. Several reviews contain extensive lists of drugs known to provoke delirium[47,48]. The Beers criterion for potentially inappropriate medications in the elderly is also a helpful guide in determining which medications to avoid or eliminate[49]. However, it is important to emphasize that there is conflicting evidence concerning the potential of many drugs and/or drug classes to provoke delirium (eg-anticholinergics [33]). Therefore, the recommended quality initiatives concerning medication management do not focus on specific drugs. Rather, it is recommended that the patient's medication regimen be simplified as much as possible and regularly assessed for drugs with the potential of precipitating delirium.

Alcohol abuse is a risk factor for postoperative delirium and postoperative cognitive decline[50, 51]. Alcohol abuse in the elderly is often underdiagnosed. The prevalence of problem drinking among the elderly is unclear[52]. It is important to try and obtain an accurate history concerning alcohol use from the elderly surgical patient. This information can be used for planning postoperative care such as management of alcohol withdrawal symptoms, and helps in determining if the patient will be at high risk for postoperative delirium.

Anesthesia management—Most studies examining elective surgery suggest no difference in postoperative delirium when regional and general anesthesia are compared[53]. Many comparisons have been made among different general anesthetic regimens in terms of delirium prevention. The only positive outcome has been in cardiac surgery patients where

administration of 0.5 mg/kg ketamine on induction was associated with decreased postoperative delirium in comparison to a fentanyl/etomidate anesthetic [54]. However, the results require verification as the study was underpowered (n=29/group).

Controlling the level of sedation during regional anesthesia does prevent delirium in high risk populations. A recent randomized double blinded trial examined the question of whether light vs. deep sedation can decrease the incidence of postoperative delirium [55]. In elderly patients undergoing hip fracture repair with spinal anesthesia, subjects were randomized to receive either light or deep sedation with propofol and followed postoperatively for delirium. The study demonstrated that in this high risk population, light sedation decreased the incidence of postoperative delirium by 50% compared with deep sedation. The effect was associated with a mean reduction of almost one day of delirium for the light sedation group. This study points to the role of excessive sedation during the perioperative period as a risk factor for delirium in highly vulnerable populations.

There is no clear consensus as to whether intraoperative hemodynamic management prevents postoperative delirium. Large retrospective analyses of geriatric populations have found no association between intraoperative hypotension or hemodynamic complications and increased delirium incidence[27]. In randomized trials hypotensive epidural anesthesia in elderly patients is not associated with an increased incidence of postoperative delirium[56]. In contrast, hypotension may play a role in development of delirium with select subpopulations. Yocum et al. demonstrated a relationship between intraoperative hypotension and postoperative cognitive decline in patients with preoperative hypertension[57]. Until further studies are available, no recommendations for hemodynamic management can be made concerning prevention of postoperative delirium.

Summary of quality initiatives for delirium prevention in the elderly surgical patient

1. Use structured clinical protocols focused on risk factor modification for delirium management via either specialized delirium units or geriatrician-led patient management. Many of these protocols are contained in the recent NICE recommendations[58].
2. Use of low dose haloperidol for delirium prophylaxis in high risk elderly orthopedic surgical populations should be considered.
3. Older surgical patients should be evaluated for dementia and a history of alcohol abuse at time of admission to identify patients at high risk for postoperative delirium.
4. Correction of abnormal preoperative laboratory values (especially electrolytes and glucose).
5. When using narcotics for pain management, avoid meperidine
6. A multimodal approach to pain management will help to reduce potential side effects of narcotics.
7. The patient’s medication profile should regularly be assessed for simplification with an eye towards avoiding polypharmacy and drugs reported to precipitate delirium.
8. Dexmedetomidine may be the drug of choice for long term sedation in the ICU.
9. During regional anesthesia in high risk populations the level of sedation should be monitored and deep sedation avoided.

Cardiopulmonary Considerations

In addition to neurocognitive complications in the elderly, cardiovascular and pulmonary issues present the largest threat to older patients in the postoperative period. The increased morbidity from these complications represents a combination of increased incidence of cardiac and pulmonary disease as well as an intrinsic vulnerability due to predictable age related changes. Turrentine et al[7] examined the American College of Surgeons National Surgical Quality Improvement Program data from their institution from 2002 to 2005 and found that patients over 80 years had higher morbidity and mortality (51% and 7%) vs. all patients (28% and 2.3%) following surgical procedures. Multiple studies have confirmed an excess in mortality and morbidity in older patients, especially following emergency procedures[59]. There is limited data on successful post-surgical quality improvement initiatives specific to the elderly population. There are, however, several strategies to reduce cardiopulmonary complications described that are highly applicable to the geriatric population.

PULMONARY

As with other postoperative complications, pulmonary complications following surgery lead to increased morbidity, length of stay and perioperative mortality in elderly patients[6]. Manku et al[8] also found that older patients with in hospital postoperative pulmonary and renal complications had increased mortality after hospital discharge, especially in the first 3 months. Although comorbidities predispose patients to postoperative complications, a recent systematic review of the available evidence reported that age remains a significant risk factor for pulmonary complications even after adjusting for the presence of comorbidities[60, 61]. When compared to patients less than 60 years, the risk of a postoperative pulmonary complication is twice as high in patients' age 60 to 69 years and there is a 3 fold increase in patients aged 70–79 years[62]. Although it is known that older age is associated with an increase in pulmonary complications there are few trials specifically addressing the reduction of complications in older patients per se, so most recommendations are extrapolated from general adult data.

Pulmonary quality initiatives based on randomized controlled trials and clinical guidelines

A rigorous review of available data identified patient and procedure related risk factors for pulmonary complications following non cardiac surgery[61–63]. Patient related risk factors with good evidence include advanced age, ASA>2, congestive heart failure, functional dependency, and chronic obstructive pulmonary disease. The most important procedure related risk factor with good evidence is surgical site; unadjusted complications rates were 20% for upper vs. 8% for lower or 14% for any abdominal surgery[61, 62], and abdominal, aortic and thoracic surgery carry the highest risk of a perioperative pulmonary complication. Additional procedure related risks include emergency surgery, length of procedure over 3 hours, general anesthesia and multiple transfusions[61].

The American College of Physicians has compiled several guidelines that provide recommendations on perioperative pulmonary care that are applicable to older patients[60–64].

Pulmonary risk factors

Long acting neuromuscular blockade—One of the few areas in the literature supported by good evidence addresses the administration of long acting muscle relaxation agents. In a randomized controlled trial Berg et al[65] compared long acting versus intermediate acting muscle relaxants in 691 patients undergoing non cardiac surgery. They found that 26% of patients receiving pancuronium vs. 5% ($p<0.001$) receiving atracurium or vecuronium had residual block. In patients with residual blockade, patients that received

pancuronium also had a higher rate of pulmonary complications 17% vs. 5% (P<0.02). Although this trial was not designed to address age risk factors per se, their conclusions are highly relevant to the elderly patient for several reasons[63, 65].

Advanced age is associated with a gradual decrease in chest wall compliance and decreased respiratory muscle strength, so any diminution in strength may lead to hypoventilation and postoperative pulmonary complications. In addition older patients have blunted responses to hypoxia and hypercapnia, thus respiratory drive is also impacted[66]. In general it is reasonable to conclude that the evidence supports that long acting neuromuscular blockers such as pancuronium should be avoided in elderly patients.

Intraoperative anesthetic technique—The role of neuraxial anesthesia and analgesia in preventing complications is a controversial area. There are no good randomized trials looking specifically at elderly patients, although many older patients are included in most studies. The results of two meta-analyses reviewing outcome data in patients receiving either general anesthesia or epidural or spinal anesthesia found some trends in improved outcomes in the epidural or spinal group[67, 68]. However there are some major issues with the data. First, a large proportion of the surgeries were orthopedic surgery, which by most criteria are relatively low risk surgeries for pulmonary complications. Furthermore the small subject numbers in several studies included and the lack of data regarding intraoperative and medication fluid use make it difficult to reach a conclusion about regional anesthesia. Postoperative analgesia does appear to be superior with epidural analgesia for aortic and upper abdominal surgery, but has not been shown to reduce the risk of pulmonary complications[61, 63, 64].

Lung expansion—Postoperative pain, drowsiness, immobilization and bed rest are just a few of the postoperative events that can lead to shallow breathing, and the potential development of atelectasis and subsequent pulmonary complications. Lung expansion modalities include chest physiotherapy, deep breathing exercises, incentive spirometry, and continuous positive airway pressure[63, 66]. The goal of these procedures is to increase the postoperative functional residual capacity and expand partially or completely collapsed alveoli. A recent Cochrane meta-analysis included 1160 patients from trials comparing incentive spirometry to no respiratory treatments, physiotherapy and deep breathing[69]. They did not find sufficient evidence to support the use of incentive spirometry in the postoperative period. In contrast, the American College of Physicians clinical guidelines[61, 63] developed following a systemic review of the literature did support the use of lung expansion modalities including both incentive spirometry and continuous positive airway pressure[63]. The difference in evidence may reflect the methodologies of the review. The Cochrane review only included incentive spirometry, in contrast with the American College of Physicians guidelines which included all modalities. The American College of Physicians reviews suggested that any of the above mentioned interventions may be superior to no lung expansion but it is not possible to recommend one particular modality.

Surgery—As stated, surgery site is a significant risk factor for the development of postoperative pulmonary complications, and upper abdominal surgery close to the diaphragm is a significant risk factor − 13 to 33% complications compared with 1 to16% in lower abdominal surgeries[60].

Aspiration—Aging is associated with a decrease in the usual protective reflexes in the oropharnyx predisposing to aspiration. Patients with swallowing disorders, Parkinson's and other neurological syndromes are particularly high risk[66]. In cases where the airway is unprotected and in the postoperative period, administration of sedation should be carefully monitored and strict NPO guidelines adhered to even for minor non invasive procedures.

Recommendations

1. There is good evidence to recommend avoiding long acting muscle relaxants
2. Postoperative pain control- it is not possible to recommend regional vs. general anesthesia based on current evidence. However evidence does appear to support good pain control and epidural analgesia for aortic, vascular and thoracic surgery.
3. There are conflicting recommendations on lung expansion in the postoperative period. However given that elderly patients represent a high risk group there is probably benefit to providing incentive spirometry or other maneuvers to prevent prolonged atelectasis.
4. Aspiration risk is increased in the elderly and requires vigilant care.

CARDIAC

The presence of cardiac disease increases with advanced age and at the same time the number of older patients undergoing non cardiac surgery is steadily increasing making appropriate cardiac care of elderly patients extremely relevant. Multiple indices have been developed over years to identify high risk individuals prior to surgery. One of the most widely used is the Revised Cardiac Risk Index[70–72]. This tool identifies six independent risk factors that have been correlated with increased cardiac risk. These are: ischemic heart disease, congestive heart failure, cerebral vascular disease, high risk surgery, preoperative insulin for diabetes, and creatinine over 2mg per dL. Unlike the risk of pulmonary complications, age has not consistently been found to be an independent predictor of perioperative cardiac risk. However the intraoperative or perioperative mortality is higher in geriatric vs. younger patients in the event of an acute myocardial infarction. The 2009 American College of Cardiology Foundation/American Heart Association revised guidelines[64, 72–74] provide an extensive analysis of the available literature and have been recently revised to address controversial issues surrounding administration of beta blockade. Several areas are important when considering reducing risk in the elderly patient. These include the use of beta blockade and statins, the importance of blood pressure control perioperatively and the utility of a preoperative ECG. The role of these issues in reducing cardiac complications will be discussed briefly.

Cardiac quality initiatives based on randomized controlled trials and clinical guidelines

Beta blockers—Early data on perioperative beta blocker use resulted in widespread perioperative administration of beta blockers to low and moderate risk as well as high risk patients. Data from a more recent randomized control trial including over 8000 patients found a reduction in myocardial infarction, coronary revascularization and atrial fibrillation within 30 days of surgery in the metoprolol vs. placebo group. However they also found a significant increase in death, stroke and hypotension and bradycardia. These data and others have resulted in a reevaluation of the beta blockade recommendations. The most recent guidelines[72, 75] recommend (class 1 evidence) that beta blockers should be continued in patients who are currently receiving beta blockers during the perioperative period. There is Class 2a evidence to suggest that beta blockers should be administered to patients with inducible ischemia on testing prior to high risk vascular surgery. There is also some evidence to recommend beta blockers for high risk patients, defined as more than one clinical risk factor, undergoing vascular or intermediate surgery, with careful titration of heart rate and blood pressure. In contrast to the earlier guidelines, beta blockers are not recommended in patients undergoing low risk surgery. These recommendations are not specific to the elderly but clearly will impact a large percentage of vascular patients.

Statins—Statins have been shown to reduce lipid levels, decrease vascular inflammation and stabilize atherosclerotic plaques. Several trials have demonstrated significant benefits in patients with coronary artery disease demonstrating a reduction in myocardial infarction, stroke and death[64, 73]. Recommendations for perioperative statin use are based on observational data and there are limited randomized trials. Current guidelines recommend that patients undergoing vascular surgery be started on statins in advance of surgery, preferably 30 days. Abrupt discontinuation of statins has been associated with increased risk of myocardial infarction and death and continuing statin therapy in the perioperative period is recommended. Statins are not available intravenously. However, there are extended release formulations (for example fluvastatin) available that may be used to bridge the NPO status over surgery.

Hypertension—Hypertension is extremely prevalent among the elderly and is associated with increased incidence of coronary artery disease and other comorbidities such as cerebrovascular and renal disease. The perioperative period represents a unique opportunity to evaluate hypertensive therapy, compliance and efficacy. Every effort should be made to control hypertension preoperatively, and it is also important to avoid abrupt discontinuation of antihypertensive therapy. Despite widespread prevalence of hypertension in the geriatric population, there is no strong evidence that stage 1 or 2 hypertension is consistently associated with increased cardiac risk during surgery. However hypertension is associated with increased lability of blood pressure and intraoperative hypotension has been associated with postoperative myocardial infarction and mortality[76, 77]. In a prospective observational study of over 8000 patients undergoing general, urological and vascular surgery Kheterpal et al identified 9 risk predictors for a cardiac adverse event. These predictors were age >65 years, BMI >30, emergent surgery, prior cardiac intervention or surgery, active congestive heart failure, cerebrovascular disease, hypertension, operative duration >3.8 hours, and administration of packed red blood cells intraoperatively. They also found that high risk patients experiencing hypotension or tachycardia were more likely to experience a cardiac adverse event.

ECGs—The value of a routine preoperative ECG in elderly patients undergoing non cardiac surgery has been debated. Earlier recommendations included age based requirements for preoperative ECGs. Although abnormal ECGs are prevalent in the elderly population, abnormal preoperative ECGs have not been predictive of a postoperative event and are no longer recommended universally. Current guidelines (Class 1 evidence) state that ECGs are indicated in patients with at least one risk factor in patients undergoing vascular surgery and in patients with coronary heart disease, cerebrovascular disease or peripheral vascular disease undergoing intermediate or high risk surgery. There is Class 2 evidence to support obtaining a preoperative ECG even in patients with no clinical risk factors but whom are undergoing vascular surgery and in those with at least one risk factor undergoing intermediate risk surgery. In contrast to earlier recommendations a preoperative ECG is not recommended in asymptomatic patients undergoing low risk procedures[73].

Thermoregulation—Perioperative hypothermia has been shown to be a significant cause of postoperative adverse events including: poor wound healing, susceptibility to infections, shivering, discomfort and increased cardiovascular stress and subsequent complications. Numerous age related physiological changes predispose the older patient to the development of hypothermia. These include impaired central temperature regulation, altered shivering threshold, impaired vasoconstriction, and reduced metabolic activity. Perioperative temperature management is now a recognized Physician Quality Reporting Initiatives measure for Anesthesiologists.

Summary

1. Risk stratification. The revised cardiac risk index is a useful way to identify patients with increased cardiac risk during surgery as well as an indicator of longer term prognosis.
2. Beta blockers should be continued around surgery and administered perioperatively to high risk individuals undergoing intermediate or high risk surgery as outlined by the American College of Cardiology Foundation/American Heart Association guidelines. Indiscriminate and wide spread use of beta blockers is not recommended.
3. Statins in the perioperative period are indicated in patients with high risk indices undergoing intermediate and high risk surgery. Perioperative statin use should not be abruptly discontinued in the perioperative period.
4. Preoperative ECGs are indicated in patients with cardiac risk factors and active disease under going at least intermediate surgery. Age based criteria for patients undergoing low risk surgery is not recommended to guide ordering of preoperative ECGs.
5. Hypertension should be controlled, but limited evidence to suggest postponing elective surgery. Observational data suggests that perioperative hypertension and intraoperative hypotension may be associated with increased risk of myocardial infarction and mortality following surgery. Further data analysis in this area is needed.
6. Temperature management is required for older patients, whom may require more active warming compared with younger patients.

Process Measures and Quality

Despite the growing popularity of quality measurements in healthcare, there are few recognized quality measures directed at the elderly surgical population. This is at odds with the actual surgical morbidity and mortality data that have repeatedly shown that older patients have increased morbidity and mortality following surgery. The standard quality assessment performance measures for surgery (myocardial infarction, surgical site infection and deep venous thrombosis) are not specific to the elderly. Although older patients do have a higher incidence of cardiac complications, the same has not been shown for deep venous thrombosis and surgical site infection. It seems clear that the development of more relevant quality improvement methods and markers for elderly surgical patients are needed especially for postoperative pulmonary and urological complications[6]. In the meantime markers that examine process are being developed[78]. Process measures look at multiple aspects of care such as interpersonal communication, diagnostic and treatment strategies. It seems possible that these more global markers may provide a relevant method of assessing the quality of care in complex elderly patients. Using an exhaustive process involving expert review panels, structured interviews, and literature reviews, McGory et al[78] identified 96 perioperative quality candidate indicators of care in 8 domains for elderly surgical patients. These domains include comorbidity assessment, medication usage, patient's provider discussion, postoperative management, discharge planning, and ambulatory surgery. Within each domain a number of quality indicators were identified. In many instances these are quite specific to the elderly; for example, an assessment of an elderly patient's decision making capacity and specific discussions about expected functional outcome. This approach provides an opportunity to investigate in more elder specific issues. However there are significant difficulties in implementing follow up on such a vast number of both objective

and subjective indicators. Despite these challenges measuring quality of care is especially important given the excess morbidity and mortality in this growing population.

In conclusion, elderly patients represent a significant portion of the patients that anesthesiologists are currently taking care of and will be in the future. Quality measures and evidence based strategies to reduce potential complications are present in some areas. However, there are limited geriatric specific data to direct care of the elderly patients. The value of process based measures is as yet unknown, but appears to hold promise for the geriatric patient.

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Table 1

Risk factors for delirium and standardized protocols*

Risk factor	Standardized protocol
Cognitive impairment	Orientation protocol: board with names of care team members and day's schedule; communication to re-orient to surroundings Therapeutic activities protocol: cognitively stimulating activities three times daily (e.g.-discussion of current events, or word games)
Sleep deprivation	Nonpharmacologic sleep protocol: at bedtime, warm milk or herbal tea, relaxation tapes or music, and back massage Sleep-enhancement protocol: unit wise noise reduction strategies, and adjust schedules to allow sleep (e.g.-medications and procedures)
immobility	Early-mobilization protocol: ambulation or active range of motion exercises three times daily, minimal use of immobilizing equipment
Visual impairment	Vision protocol: visual aids (glasses or magnifying lens)and adaptive equipment (e.g.-large print books) with daily reinforcement of their use
Hearing impairment	Hearing protocol: portable amplifying devices, earwax removal, and special communication techniques with daily reinforcement of these adaptations
dehydration	Dehydration protocol: early recognition of dehydration and volume repletion (encourage oral intake of fluids)

Adapted from [16].